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THE SUBSTITUTION OF GRAIN SORGHUM BY SUGARCANE JUICE IN DIETS FOR GROWING PIGS [1]

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Young crossbred pigs (28.7 kg mean initial liveweight) were given varying proportions of sugarcane juice or milled sorghum as the principal dietary energy source as follows: 0:100 (control), 50:50, 75:25 and 100:0 (dry matter basis). A protein supplement was also given, being composed of soyabean meal, fishmeal, coconut meal and synthetic lysine. Diets were adjusted to give similar DM and nitrogen contents. The trial was repeated in two periods (replicas).

There were no significant differences in liveweight gain between diets, but there was a significant difference ($P < 0.01$) between periods (491.0 and 602.3 g/d for periods 1 and 2 respectively). Feed conversion also showed a tendency ($P = 0.14$) to be better for the second period. The improvement in performance may be explained in the higher concentration of total sugars in the juice during the second period.

It would appear that even young pigs adapt to, and have the ability to utilize efficiently, diets based on sugarcane juice, and that this can effectively replace grain as the principal dietary energy component.

Key words : pigs, sugarcane, sugarcane juice, sorghum, growth

In a previous work on fattening pigs, liveweight gains of around 700 g/d were obtained for diets in which grain was substituted completely by fresh sugarcane juice (Mena et al 1981). However, it would be expected that younger pigs would be less able to take advantage of a diet as rich in sugars as sugarcane juice.

This work, therefore had as its principal objective the investiagtion of the effect of the level of sugarcane juice in different combinations with grain sorghum in diets for growing pigs.

Materials and Methods

Treatment, design and animals: The four treatments used were different proportions (dry matter basis) of sugarcane juice and grain sorhum: 0:100 (control), 50:50, 75:25 and 100:0, as the pricipal energy source in the diet. 5 groups of 3 pigs in each one were used for each of the replicas, with two groups receiving the control diet and 1 group in each replica receiving the other diets. The work was carried out at two times (replicas): between the 18th December 1980 and 10th February 1981 (replica 1) and from the 28th February to the 16th April 1981 (replica 2). Crossbred pigs of Yorkshire x Hampshire were used, these being obtained from the commercial herd at the Facultad de Medicina Veterinaria y Zootecnia of the University of Yucatan. Castrated males were used, with initial weights of 29.8 ± 4.1 (replica 1) and 27.5 ± 2.0 kg (replica 2).

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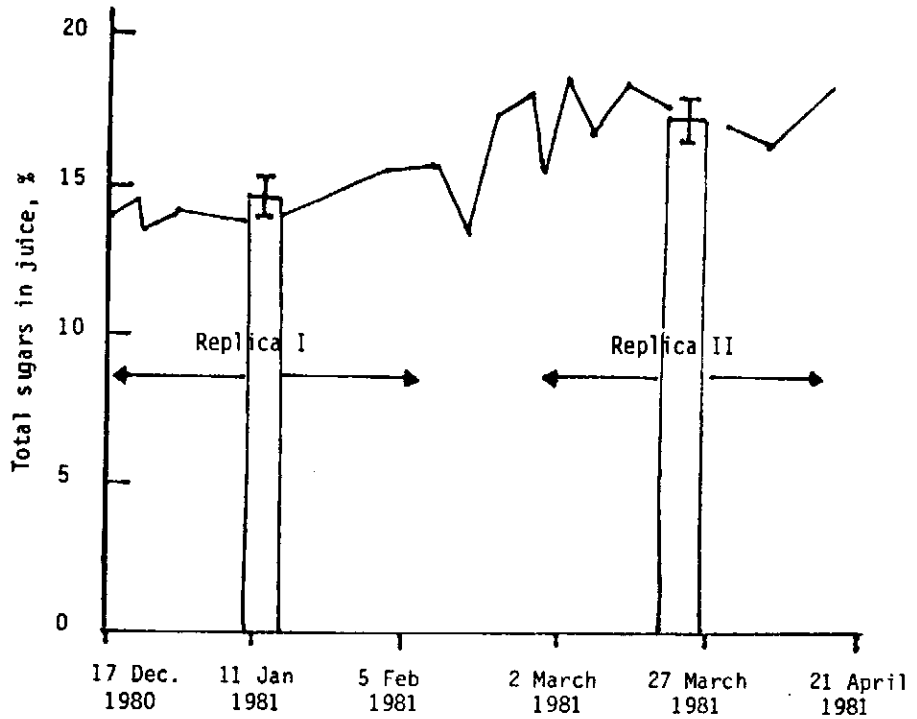
Experimental diets: The sugarcane was brought from the Ejido Justicia Social, which is situated about 200 km from the Faculty. It was brought 3 times a week and for each lot total sugars in the juice were determined. Variation of concentrations of sugars with time during the experiment is presented in Figure 1. Juice extraction was carried out using a simple

Figure 1:
Variation in the concentration of total sugars in the cane used in the experiment and means ($\bar{x} \pm SE_{\bar{x}}$) for the two replicas



cane mill with a capacity of 1500 kg/h and an efficiency of extraction of 50% of juice (based on the weight of the stalks). The other dietary components were milled grain sorghum, soya meal, fishmeal, coconut meal and synthetic lysine. For each dietary treatment a supplement was prepared which consisted of the protein components and the corresponding quantity of grain sorghum, which mixtures are shown in Table 1.

The compositon of the supplement was worked out according to the different proportions of juice and grain sorghum, with the objective of making the four rations isonitrogenous.

Housing and management: The pigs were housed in corrals of 2.5 x 2 m in a rustic building open at the sides, made from concrete blocks and with a thatched roof.

The protein supplement, with or without milled sorghum, was given in a separate trough to that which was used for the sugarcane juice. Both the juice and the supplements were given at the same time, at 0900 h, after weighing the refusals of juice and supplements from the previous day. In

Table 1:
Composition of supplements used

	Treatments (grain/juice)			
	100:0	50:50	25:75	0:100
Composition (%, dry matter basis)				
Sorghum	71.5	51.3	31	-
Soyabean meal	15.8	31.6	46.4	70.7
Fish meal	3.0	4.1	5.2	7.0
Coconut meal	6.0	8.2	10.5	14.0
Vitamins and minerals	3.5	4.7	6.1	8.2
Lysine (D-L)	0.24	.17	.12	-
Intake[1], kg/d				
Supplement	1.68	1.10	0.90	0.75
Juice[2]	-	4.94	6.81	8.97

[1] Fresh basis

[2] Mean of 16°Brix (density = 1.09)

the control treatment the balanced ration was given ad libitum. The amount of supplement to be given to the other groups was fixed by the consumption of the control ration, with the objective of keeping the daily consumption of protein as uniform as possible for all groups. The quantities of juice given varied according to the amount of supplement given, so as to keep the dry matter (DM) consumption regular. Mean consumption of supplements and juice on a fresh matter basis are given in Table 1.

Measurements: Pigs were weighed at the start of the trial and there - after every 14 days, finishing the trial when the pigs in each group reached a mean weight of approximately 55 kg. Individual weight gains were calculated using a linear regression of weight against time. Intake was measured on a fresh basis, and samples were taken of the dietary components for DM analysis.

Results

Two animals of the first replica in one of the control groups had problems with their trotters, which made slaughter necessary . There were no problems with diarrohea , although the faeces showed a tendency to be more liquid as the level of juice in the diet increased. Mean weight gains and intakes for each replica are given in Table 2.

In view of the obvious difference in liveweight gain between the two replicas, statistical analysis was undertaken (Table 3) according to a randomized factorial design, using the different times as replicas.

There were no significant differences in liveweight gain between the different diets, but there was a significant difference between replicas (times)($P < 0.01$). The interaction between diets and replicas was also significant ($P < 0.005$). There was a tendency ($P = 0.14$) for the difference between replicas to be significant with respect to feed conversion (Table 4 and Figure 3). Both for liveweight gain and for feed conversion, the results were better in the second replica. Moreover, as the level of juice in

Table 2:

Mean values for liveweight gain and DM intake for pigs fed different proportions (DM basis) of grain sorghum and sugarcane juice from 25 - 55 kg liveweight, 2 replicas.

	Proportion of grain:juice (DM basis)			
	100:0	50:50	25:75	0:100
Increase in liveweight gain, g/d				
Replica I	568	533	453	410
Replica II	535	507	667	700
DM intake, kg/d				
Replica I[1]	1.61	1.70	1.66	1.82
Replica II[2]	1.64	1.51	1.69	1.89

[1] Replica I from 17/12/80 - 10/2/81: 14.6 ± 0.2% total sugars in the juice

[2] Replica II from 27/2/81 - 16/4/81: 17.2 ± 0.3% total sugars in the juice

Table 3:

Analysis of variance for liveweight gains

Source of variation	Degrees of freedom	Mean square	F	Probability
Treatments	3	1900	.23	.5
Replicas	1	58600	7.3	.01
Replicas x treatments	3	46500	5.8	.005
Error	20	8100		

Table 4:

Analysis of variance for feed conversion

Source of variation	Degrees of freedom	Mean square	F	Probability
Treatments	3	.149		
Replicas	1	1.015	2.57	0.14
Replicas x treatments	3	.395		

creased the liveweight gain increased in replica 2, whilst the reverse was true in replica 1.

Discussion

It is well known that piglets in the first week of life are not able to break down sucrose (Kidder et al 1968); However, the capacity to utilise sucrose increases rapidly with age (Kidder and Mendez 1978), and according to these authors, the levels of sucrose in the small intestine increase up to the end of the second year in pigs. Ly (1975) also found considerable variation during the period 9 - 30 days of age with respect to the quantity

of total sugars present in the appendices of pigs fed on a diet of final molasses. Half of the sugars found were fructose and one third sucrose.

In a comparison of carbohydrate sources, Ly et al (1970) found that concentrations of reducing sugars in the blood were higher for a diet of primary molasses (with the principal sugar form being as monosaccharides), than for a diet of final molasses (35% sucrose and 17% reducing sugars). Levels of reducing sugars in the blood were lowest for maize based diets. However, for 40 pigs, fitted with cannulae in the ileum ,and fed a basal diet of final molasses and torula yeast, Ly (1971) obtained digestibilities for total sugars in the range 97 - 99%.

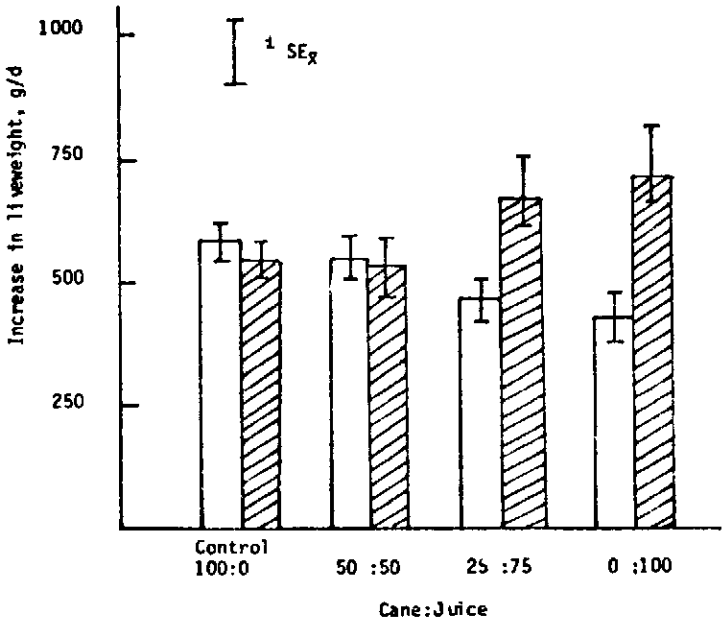
From the animals performance observed in the present experiment it would appear that pigs adapt to, and have the ability to utilise efficiently, diets based on sugarcane juice, from an initial weight of 25 kg liveweight.

Moreover, it should be noted that the pigs receiving sugarcane juice diets were in effect receiving a restricted diet, as the quantity of juice given was controlled by the intake of the control (cereal-based) diet.

The liveweight gains obtained from this trial were similar to those reported by Lescano (1979) and Velásquez et al (1972), for young pigs (25- 50 kg).

An interesting result from the present trial was the difference between the two replicas that were carried out at different times (Figure 2).

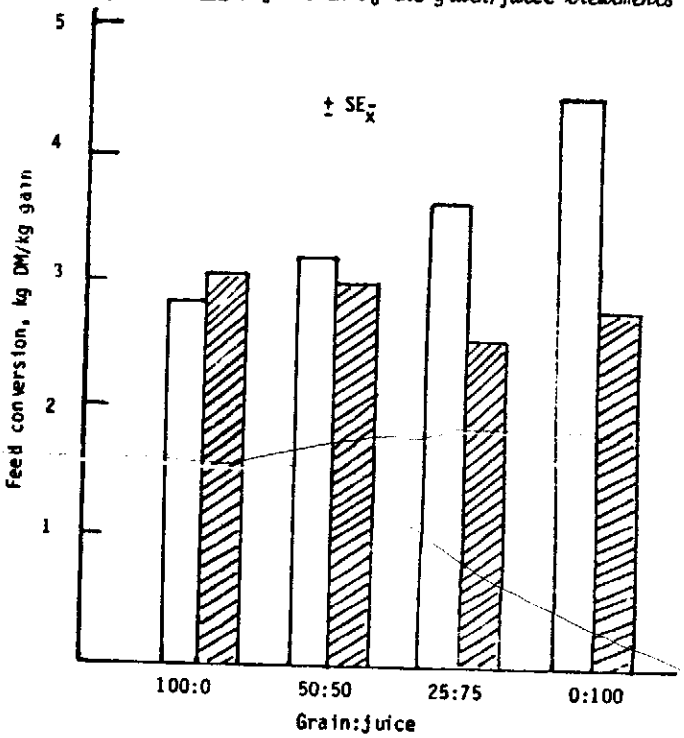
Figure 2:
Mean values for liveweight gain for pigs (Replica I and Replica II) for each of the grain:juice treatments



Although there were no important differences in the rainfall or mean temperature between the two periods (December - February and March - April) , there was a very significant increase in the concentration of total sugars in the juice in the second time period (Figure 1).

At the present time we cannot explain the reason for the apparent improvement in liveweight gain with higher concentrations of total sugars in

Figure3:
Mean values for feed conversion for pigs (Replica I ☐ Replica II ▨) for each of the grain/juice treatments



the juice, and it is suggested that this aspect should be the object of further studies.

Conclusions

The results of this work indicate that pigs, even in the initial stages of growth (initial liveweight 25 kg), can be fed on sugarcane juice as the only energetic dietary component. The degree of importance of the concentration of total sugars in the juice merits a full investigation.

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